Monitoring rainfall trends over Eastern and Southern Africa

Francis K. Muthoni[1], Vincent O. Odongo[2], Justus Ochieng[3], Irmgard Hoesche-Zeledon[1], Mulundu Mwila[4], Bekunda Mateete[1]

[1]International Institute of Tropical Agriculture (IITA), Tanzania, [2]Wageningen University, Netherlands; [3]World Vegetable Center, Tanzania, [4]ZARI, Zambia

Abstract

This study investigated the spatial-temporal trends in rainfall over 7 countries in East and Southern Africa (ESA) region to inform evidence-based targeting of climate smart agriculture (CSA) technologies. Climate Hazards group Infrared Precipitation with Stations version two (CHIRPS-v2) remote sensing data spanning 37 years (1981 - 2017) was used. CHIRPS-v2 data had a satisfactory skill to estimate monthly rainfall with Kling-Gupta efficiency (KGE) of 0.68. Significant increase in annual rainfall occurred in Southwest Zambia, Western Kenya and Eastern Uganda. Significant decrease in annual rainfall was observed in Southwest Tanzania and Central-South Kenya as well as Central Uganda and Western Rwanda. CHIRPS-v2 rainfall product provides reliable high spatial resolution information on amount and variability of rainfall to complement sparse rain gauge network in rain-fed agricultural systems in ESA region. The observed spatial-temporal trends in rainfall will guide targeting of CSA.

Keywords: Climate change, spatial targeting, remote sensing

Introduction

Over 70% of livelihoods in ESA region depends on rain-fed agriculture, therefore they are highly vulnerable to climate change and variability. Understanding spatial and temporal patterns of climate change and variability is a key step towards designing and targeting appropriate adaptation strategies. Spatially-explicit analysis of long-term trends in rainfall identifies zones experiencing decreasing or improving agricultural potential. Understanding past trends in climate can inform future trajectories to support decisions on spatial targeting of appropriate adaptive measures.

Materials and Methods

CHIRPS-v2 data was used to analyse long-term trends and variability of monthly and annual rainfall (1981 - 2017) in ESA region. Agreement between monthly CHIRPS-v2 and gauge station data evaluated using modified Kling-Gupta efficiency (KGE). Modified Mann-Kendall procedure used to test significance of trends (p < 0.1). Slope of the trends quantified using Theil-Sen method.

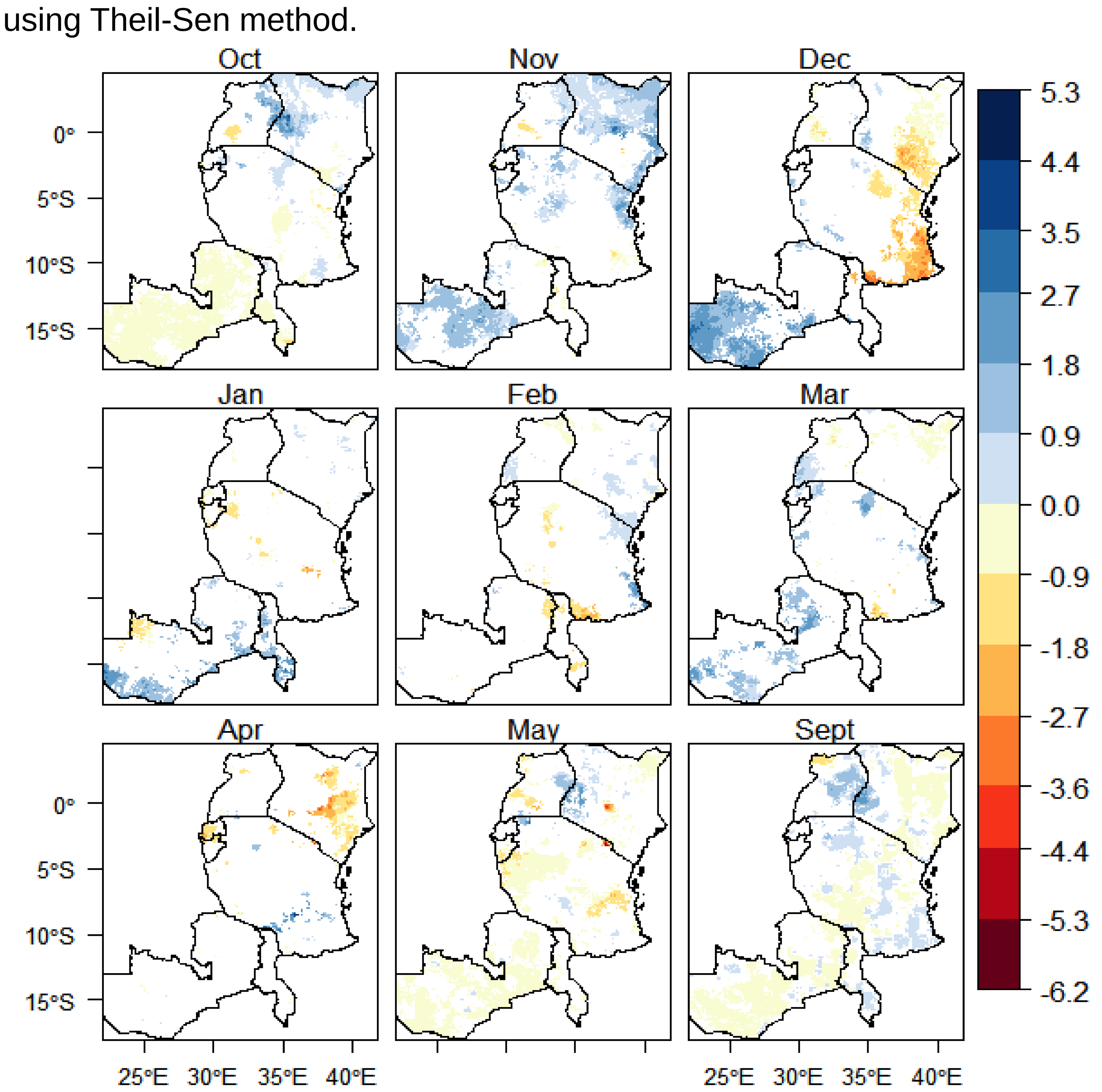

Fig. 1: Significant trends in monthly rainfall (mm yr^{-1}) between 1981 and 2017 in ESA region

Results and Discussion

Zones experiencing significant increasing or decreasing monthly (Fig. 1) and annual rainfall trends (Fig. 2) were identified. CHIRPS-v2 rainfall showed high skill to estimate gauge observations (KGE = 0.68; Fig. 3).

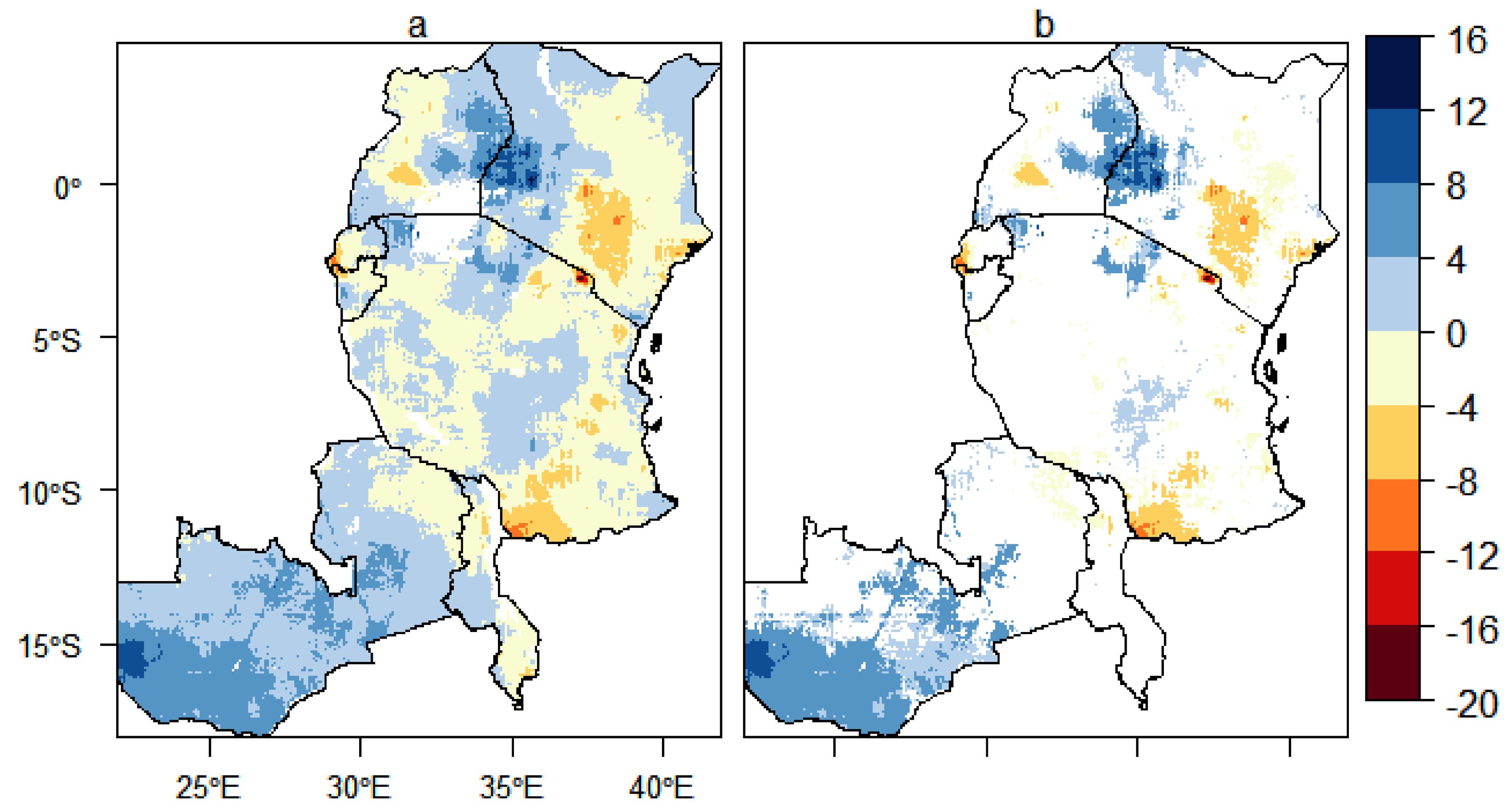

Fig. 2: (a) Monotonic trends of annual rainfall (mm yr^{-1}) in ESA region for 1981 - 2017 period and (b) zones with significant (p < 0.1) trend

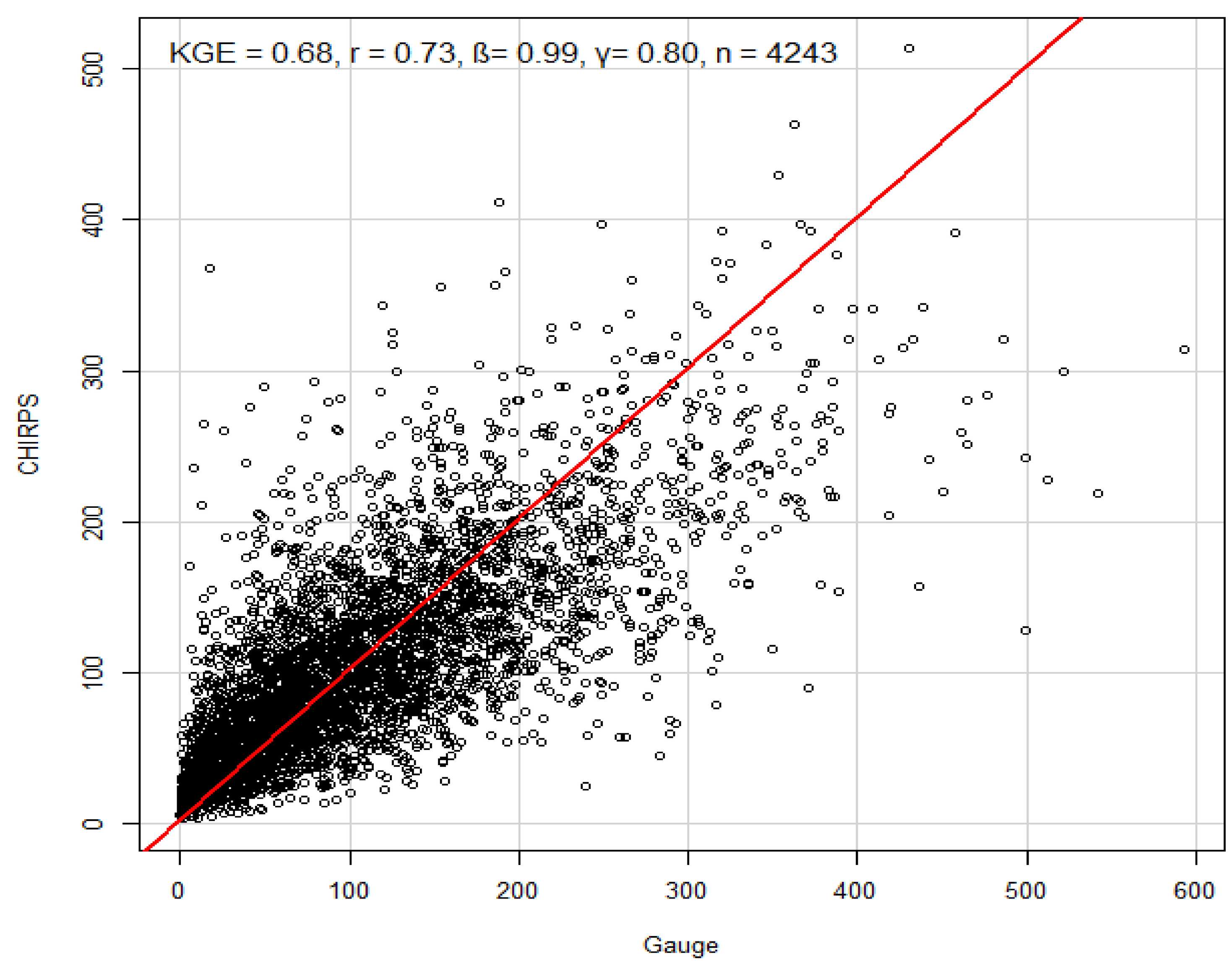

Fig. 3: Agreement between CHIRPS-v2 and gauge station rainfall data. The solid line indicates 1:1 relationship

Conclusion and Recommendation

- CHIRPS-v2 is a reliable dataset for monitoring spatial-temporal trends and variability of rainfall over regions with low density of gauge stations.
- Provide new insights to policy makers on priority areas for adapting agriculture to climate change and variability
- Provide tool to support evidence-based scaling out of appropriate CSA technologies.

References

Muthoni, F.K., Odongo, V.O., Ochieng, J., Mugalavai, E.M., Mourice, S.K., Hoesche-Zeledon, I., Mwila, M., Bekunda, M., 2018. Long-term spatial-temporal trends and variability of rainfall over Eastern and Southern Africa. Theoretical and Applied Climatology.

Acknowledgements

Funded by USAID through grant numbers: AID-BFS-G-11-00002 and MTO 069018 under the Feed the Future initiative to support Africa RISING program.